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A geodynamic model of subduction evolution to explain Australian plate acceleration and deceleration during the latest Cretaceous-Early Cenozoic

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The northern margin of the Australian plate, in the region of present-day New Guinea, was characterized by a large north dipping subduction zone consuming a marginal basin during the latest Cretaceous (Maastrichtian) and Early Cenozoic. Observational data imply that the subduction zone was active at ~71-50 Ma, and suggest that it was responsible for plate acceleration from ~1 to ~7 cm/yr between 66 and 59 Ma, and plate deceleration from ~7 to ~0 cm/yr between 52 and 49 Ma. A numerical model of buoyancy-driven subduction is presented to simulate the latest Cretaceous-Early Cenozoic geodynamic setting of the New Guinea region and to test if the rates of plate acceleration and deceleration can be ascribed to the progressive evolution of a subducting slab, from an initial transient subduction phase to the terminal stage of subduction involving slab detachment. The geodynamic model can reproduce the first-order plate velocity evolution of the Australian plate and demonstrates that plate velocity increases and decreases of the order of 5 cm/yr, due to transient early and terminal subduction phases, respectively, can occur over periods lasting only a few Myr.